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SPECIFICATION

TITLE

"METHOD AND DEVICE FOR PRINTING WHEREIN A HYDROPHILIC LAYER IS PRODUCED AND STRUCTURED"

BACKGROUND

The method and device relate to generating a print image on a carrier material. On the surface of the print carrier ink-attracting and ink-repelling regions are generated corresponding to the structure of the print image to be generated. The ink-repelling regions are provided with a layer from an ink-repelling medium. Ink that adheres to the ink-attracting regions and is not accepted by the ink-repelling regions is applied on the surface of the print carrier. The ink distributed on the surface is printed on the carrier material.

In the prior art, offset printing methods operating without water are known whose non-printing regions are fat-repelling and therefore accept no printing ink. In contrast, the printed regions are fat-attracting and accept the fat-containing printing ink. Ink-attracting and ink-repelling regions are distributed on the printing plate corresponding to the structure of the print image to be printed. The printing plate can be used for a plurality of transfer printing events. A new plate with ink-attracting and ink-repelling regions must be generated for each print image.

From United States Patent No. 5,379,698, a method (called the Direct Imaging Method) is known in which a printer's copy is created in the printing device via selective burning-off of the silicon cover layer on a multilayer, silicon-coated film. The silicon-free locations are the ink-attracting regions that accept printing ink during the printing event. It requires a new film for each new print image.

In the standard offset method operating with water, hydrophobic and hydrophilic regions are generated on the surface of the print carrier corresponding to the structure of the print image to be printed. Before the application of the ink, a thin moisture film that wets the hydrophilic region of the print carrier is first applied onto the print carrier using application rollers or

spray devices. The ink roller subsequently transfers ink onto the surface of the print carrier that, however, exclusively wets the regions not covered with the moisture film. The ink is finally transferred onto the carrier material after the inking.

In the known offset printing method, multilayer, process-less thermoprinting plates can be used as print carriers (compare, for example, WO00/16988). On the surface of the print carrier, a hydrophobic layer is removed via partial burn-off and a hydrophilic layer is uncovered, corresponding to the structures of the print image to be printed. The hydrophilic layer can be wetted with an ink-repelling fountain solution. The hydrophobic regions are ink-accepting and can accept printing ink during the print event. A new printing plate must be used to create a new print image.

Furthermore, a method is known from US-A-6,016,750 in which an ink-attracting substance is separated from a film by means of a thermotransfer method, transferred to the hydrophilic surface of the print carrier and solidified in a fixing process. In the printing process, the hydrophilic regions remaining free are wetted with an ink-repelling fountain solution. The ink is subsequently applied on the surface of the print carrier, the ink, however, bonding only on the regions provided with the ink-attracting substance. The inked print image is then transferred onto the carrier material. A new film with the ink-attracting substance is necessary for the creation of a new print image.

In the standard offset method or surface printing method, the wetting of the printing plate with the ink-repelling fountain solution is achieved via a specific roughening and structuring of the plate surface. The surface increase and porosity thereby created generates microcapillaries and leads to an increase of the effective surface energy and thus to a good wetting or spreading of the fountain solution. As further techniques, in offset printing wetting-aiding substances are added to the fountain solution. These decrease the surface tension of the fountain solution, which in turn leads to an improved wetting of the surface of the print carrier. The literature Teschner H.: Offsettechnik, 5th edition, Fellbach, Fachschriften-Verlag 1983, pg. 193 – 202 and pg. 350 is referenced in this context.

From United States Patent No. 5,067,404, a printing method is known in which a fountain solution is applied to the surface of the print format. The fountain solution is vaporized via selective application of radiant energy in image regions. The water-free regions later form the ink-bearing regions that are directed to a developing unit and are inked by means of an ink vapor. Energy-intensive partial vaporization processes are necessary to generate the structured fountain solution film.

Furthermore, the patent documents WO 97/36746 and WO 98/32608 are referenced. In the method specified in WO 97/36746, the fountain solution is generated via vaporization of a discrete water volume that condenses on the surface of the print carrier. According to WO 98/32608 and the United States Patent No. 6,295,928 derived therefrom, a continuous ice film is applied and structured . In both cases, local high thermal energy must be applied for structuring. The aforementioned documents United States Patent No. 5,067,404, WO 98/32608 (United States Patent No. 6,295,928) and WO 97/36746 by the same applicant are herewith included by reference in the disclosure scope of the present patent application.

From DE-A-10132204 (not published) by the same applicant, a CTP method (Computer-To-Press method) is specified whereby multiple structuring processes can be implemented on the same surface of the print carrier. The surface of a print carrier is coated with an ink-repelling or ink-attracting layer. In a structuring process, ink-attracting regions and ink-repelling regions are generated corresponding to the structure of the print image to be printed. The ink-attracting regions are then inked with ink. Before a new structuring process, the surface of the print carrier is cleaned and re-coated with an ink-repelling or ink-attracting layer. A fountain solution layer or an ice layer is used as a layer. This patent document DE-A-10 132 204 is herewith included by reference in the disclosure content of the present patent application.

SUMMARY

It is an object to specify a printing method and a print device that is designed simply for digital printing with alternating print images on the same print carrier and that enables a high print quality.

In a method and device to generate a print image on a carrier material, a hydrophilic layer with a molecular layer thickness is generated on a surface of a print carrier usable for printing, a surfactant layer being applied on the surface of the print carrier to generate the hydrophilic layer. As a structuring process, hydrophilic regions and hydrophobic regions are generated corresponding to the structure of the print image to be printed. At the surface of the print carrier, a fountain solution layer is applied whereby the fountain solution layer forms on the hydrophilic regions such that ink-attracting regions and ink-repelling regions are created corresponding to the print image structure. Ink that adheres to the ink-attracting regions and is not absorbed by the ink-repelling regions is applied on the surface. The applied ink is transferred onto the carrier material. Before a new structuring process, the surface of the print carrier is cleaned.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a principle representation of a print device in which a surfactant layer is applied;

Figure 2 shows schematically, a cross-section through the print carrier before and after the structuring by a laser beam;

Figure 3 is an exemplary embodiment in which a hydrophilized layer is structured;

Figure 4 is an exemplary embodiment in which an applied hydrophilic layer is structured;

Figure 5 is a schematic cross-section through the print carrier before and after the structuring of the hydrophilic layer;

Figure 6 is an exemplary embodiment in which the hydrophilization ~~ensues~~ occurs via a corona discharge;

Figure 7 is a cross-section through an insulated electrode;

Figure 8 is an arrangement given a plastic print carrier;

Figure 9 is an example for an indirect corona discharge; and

Figure 10 is a print device with a regulation of the fountain solution layer thickness.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the preferred embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and/or method, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur now or in the future to one skilled in the art to which the invention relates.

According to the preferred embodiments, a hydrophilic layer is generated in a molecular layer thickness on the surface of a print carrier usable for printing. Before the application of a fountain solution layer the hydrophilic layer is influenced in a structuring process such that hydrophilic regions and hydrophobic regions are generated corresponding to the structure of the print image to be printed. Given subsequent application of a fountain solution layer, a fountain solution film attaches only to the hydrophilic regions, such that ink-attracting regions and ink-repelling regions are created corresponding to the effected structuring. After the transfer printing and a cleaning, this same surface of the print carrier can be re-structured and if necessary provided with a modified print image.

The expenditure in the structuring is reduced by the preferred embodiment. The necessary energy in order to structure a hydrophilic layer is reduced relative to the structuring of a fountain solution layer. The necessary hardware expenditure is reduced accordingly.

According to a further aspect of the preferred embodiment, a print device is specified via which the cited method can be realized.

It is to be noted that the term ink-repelling or ink-accepting layer occurs frequently in the further specification. This layer is adapted to the ink to be applied. For example, given a water-containing fountain solution layer and an

oil-containing ink, the fountain solution layer is ink-repelling. However, if the ink is water-containing, this fountain solution layer is ink-attracting. In practice, oil-containing inks are predominantly used, such that a water-containing fountain solution layer is ink-repelling.

In Figure 1, a principle representation of a print device is shown that is designed similar to how it is specified in United States Patent No. 5,067,404 by the same applicant. A print carrier 10, in the present case a continuous band, is directed through a pre-treatment device 12 that comprises a scoop roller 14 and an application roller 16. The scoop roller 14 dips into a fluid contained in a reservoir 13, the fluid containing a wetting-aiding substance. This substance, which comprises surfactants, is applied in a molecular layer thickness on the surface of the print carrier 10 via the application roller 16. The layer thickness is typically smaller than 0.1 μm. The surface of the print carrier 10 is then directed in arrow direction P1 to a dampening system 18 that, via a scoop roller 20 and an application roller 22, applies an ink-repelling or ink-attracting fountain solution, for example water, from fountain solution reservoir 24 onto the surface of the print carrier 10. In principle, other fountain solution than water can also be used. The application of the fountain solution layer can also occur via other methods, for example via dampening or spraying. The print-active surface of the print carrier 10 is completely provided with this fountain solution layer. The fountain solution layer typically has a layer thickness smaller than 1 μm.

The generally ink-repelling fountain solution layer is subsequently structured via an image generation device 26. In the present case, a laser beam 28 is used for this. In this structuring process, ink-attracting regions and ink-repelling regions are generated corresponding to the structure of the print image to be printed. The structured fountain solution layer subsequently arrives at an inking system 30 which transfers ink from a reservoir 38 to the surface of the print carrier 10 with the aid of the rollers 32, 34, 36. The oil-containing ink attaches at regions without water-containing fountain solution. It is to be noted that the ink can also be transferred onto the surface of the print carrier 10 via spraying, scraping or condensation.

Given further transport of the print carrier 10, a transfer printing onto a carrier material 40 (in general a paper web) occurs. For transfer printing, the carrier material 40 is directed through between two rollers 42, 44. In the transfer printing process, a rubber blanket cylinder (not shown) and further intermediate cylinders that effect an ink division as this is known from the field of offset printing methods can be inserted between the roller 42 and the print carrier 10.

Given further transport of the print carrier 10, the surface of the print carrier 10 is cleaned in a cleaning station 46. The ink residues as well as the residues of the surfactant layer are hereby removed. The cleaning station 46 comprises a brush 48 and a wiping lip 50 which are brought into contact with the surface of the print carrier 10. Furthermore, the cleaning can be supported via use of ultrasound, high pressure liquid and/or vapor. The cleaning can also occur using cleaning fluids and/or solvents.

A new application of the wetting-aiding substance, for example a surfactant application, and a fountain solution application as well as a restructuring can subsequently occur. In this manner, a new print image can be printed given every revolution of the print carrier 10. However, it is also possible to print the same print image multiple times. The cleaning device 46, the device 12 and the device 26 are then switched to inactive. The print image still present in ink residues is then re-inked and transfer-printed by the inking system 30. Given this operating type, a plurality of identical print images can thus be printed.

Figure 2 schematically shows a cross-section through the print carrier 10 before and after the structuring with the aid of the laser beam 28. According to the preferred embodiment, the wetting via the application of a wetting-aiding substance is conveyed onto the print carrier surface 10. This occurs within the print cycle before the application of the ink-repelling fountain solution. The wetting-aiding substance can be applied on the surface (dependent on its physical and chemical properties) as an extremely thin layer of a few molecule layers, preferably smaller than 0.1 μm. This layer is sufficient in order to promote the wetting with the ink-repelling fountain

solution on its free surface, such that this can in turn be applied as a very thin layer 54, preferably smaller than 1 μm. The continuing print process is not impaired by the small quantity of the wetting-aiding substance, in this case a surfactant layer 52. It can easily be removed again via the cleaning process integrated into the print cycle.

Advantages primarily result in the field of surface printing or offset printing, meaning a surface printing method or offset printing method with alternating print information from print cycle to print cycle. Via the wetting-aiding layer 52, the otherwise typical roughened, porous printing plate surface can be foregone. Instead of this, a smooth surface of the print carrier 10 is possible that is to be cleaned with clearly lesser effort. A faster and more stable cleaning event is indispensable for such a digital surface printing method or offset printing method and a decisive factor for its effectiveness. The surface of the print carrier 10 accordingly has a roughness that is smaller than the roughness used in the standard offset printing method. The average surface roughness R_z is typically smaller than 10 μm, preferably smaller than 5 μm. Expressed as an average roughness value R_a, the roughness value is in a range smaller than 2 μm, preferably smaller than 1 μm.

A change in the molecular or atomic structure of the material of the print carrier as well as a wetting-aiding layer permanently and firmly anchored with the surface of the print carrier is not necessary. The additionally applied wetting-aiding substance (for example the surfactant layer 52) proposed here already deploys its wetting-aiding effect given the smallest quantities. Its influence on the properties of the print carrier 10 in all regards is accordingly negligible. A further advantage results from the now-possible abandonment of the typically present wetting-aiding additives in fountain solutions in offset printing.

According to Figure 2, the fountain solution layer 54 and the surfactant layer 52 are removed via the laser beam 28 corresponding to the required image structure. These regions are then inked with ink by the inking system 30. The cleaning is eased due to the very smooth surface of the print carrier

10, whereby the surfactant layer 52 is completely removed again. Furthermore, the wear of the surface of the print carrier 10 is reduced.

In the following Figures, functionally identical elements are designated identically. Figures 3, 4 and 5 show a further exemplary embodiment of the invention. In Figure 3, in contrast to the exemplary embodiment according to Figure 1, before the application of the ink-repelling or ink-attracting layer on the usable surface of the print carrier a structuring of a hydrophilic layer ensues with a molecular layer thickness. In the present example, a vapor device 60 is used that charges the surface of the print carrier 10 with hot water vapor. The print carrier 10 is provided with an SiO2 coating on its surface. After the vapor treatment, the print carrier 10 is dried via a suction device 62. The hot water vapor generates a hydrophilic molecule structure, for example SiOH, on the outer surface.

After the subsequent structuring via the structuring device 26 by means of laser radiation 28, hydrophilic and hydrophobic regions are created corresponding to the structure of the print image to be printed. Via the downstream dampening system 18, the entire usable surface of the print carrier 10 is contacted with a fountain solution layer, whereby the fountain solution attaches only to the hydrophilic regions, such that ink-attracting regions and ink-repelling regions are created corresponding to the aforementioned structuring. An ink application via the inking system 30 subsequently occurs, whereby the oil-containing ink attaches to regions without water-containing fountain solution. The transfer printing of the print image onto the carrier material 40 subsequently occurs.

After the further transport of the print carrier 10, its surface is cleaned in a cleaning station 46. The ink residues and the residues of a possible wetting-aiding substance are removed. A new structuring process can subsequently occur.

In the present example according to Figure 3, the hydrophilic layer on the surface of the print carrier 10 is structured corresponding to the print image. The hydrophilic layer is extremely thin and is only a few nanometers, typically smaller than 4 nm. It can therefore by structured with very low

energy expenditure during a print cycle, whereby the hydrophilic molecule layer disappears. The fountain solution application, which generates a fountain solution film only on the non-hydrophilic regions, subsequently occurs. Inking and transfer printing occurs according to the specified known principles of surface printing or offset printing. After the cleaning, in which the hydrophilic layer can also be removed (however does not absolutely have to be removed) in addition to the ink residues, the print cycle can begin anew. The hydrophilic layer is regenerated or reapplied and the hydrophilic layer is subsequently structured corresponding to the new image data.

In the example according to Figure 3, the generation of the hydrophilic layer occurs via activation of the surface of the print carrier and via a suitable change of the external molecular surface structure. For example, this can be enabled via the use of chemical activators, reactive gases and/or a suitable energy supply. In addition to the use of water vapor as in the example according to Figure 3, a hydrophilic SiOH structure can be designed on the surface via the effect of hot water and via alkaline solutions (such as, for example, NaOH). For this, the print carrier is to be provided with an SiO2 coating. It is also possible that the print carrier passes through an activator bath in order to generate a hydrophilization of the surface. The application of an activator via a jet system is also possible. A further possibility is to generate the hydrophilic layer via firing the surface of the print carrier 10. Wetting-aiding surface structures are also hereby created in a molecular layer thickness.

An advantageous arrangement is the combination of the hydrophilization with the cleaning. Thus, for example, both the cleaning and the hydrophilizing effect of a hot water jet or a hot water vapor jet can be used. The cleaning and the generation of the hydrophilic layer are then implemented in a single process step.

A further variant is shown in Figure 4. A wetting-aiding substance is hereby applied to the surface of the print carrier to generate the hydrophilic layer. For example, the pre-treatment device 12 specified in the embodiment according to Figure 1 can be used. With the aid of the scoop roller 14 and the

application roller 16, a fluid from the reservoir 13 can be applied that comprises a wetting-aiding substance, for example a surfactant, in a molecular layer thickness. Here as well the layer thickness is typically smaller than 0.1 µm. Alcohols are also considered as a further wetting-aiding substance. The application can alternatively ensue via scraping on, spraying on and vapor deposition.

Due to the very thin hydrophilic layer in molecular layer thickness, the partial removal of this hydrophilic layer can ensue via local thermal energy supply. The energy expenditure can be low due to the low layer thickness. In addition to the laser radiation 28 used in Figures 3 and 4, laser diodes, LEDs, LED combs or heating elements can also be used.

In the example according to Figures 3 and 4, a restructuring can also occur per cycle of the print carrier 10, whereby a new print image is printed per cycle. However, it is also possible (as in the example according to Figure 1) to print the same print image multiple times, whereby the existing print image is re-inked and transfer-printed by the inking system 30. The devices for the restructuring are then switched to inactive.

Figure 5 shows a cross-section through the print carrier 10 before and after the structuring via the laser beam 28 for the example according to Figure 4. The surface of the print carrier 10 is very smooth, as this is also the case in the preceding examples. The thin surfactant layer 52 is structured by the laser beam 28, meaning hydrophilic regions 68 and hydrophobic layers 64 are generated. A thin, water-containing moisture film is applied by the dampening system 18 only on the hydrophilic regions. The regions 64 are then inked by the inking system 30 with an oil-containing ink that is repelled by the fountain solution 54 in the area of the hydrophilic regions 68.

The subsequent exemplary embodiments according to Figures 6 through 9 describe the hydrophilization of the surface of the print carrier 10 via charging with free ions. These exemplary embodiments can also be combined with the example according to Figure 3.

In order to ensure a good wetting with the generally ink-repelling fountain solution film, the surface energy of the print carrier 10 must be at

least as high as the surface tension of the fountain solution film. This means that the value of the contact angle between the surface of the print carrier 10 and the fountain solution must assume a value below 90°. In practice, it is necessary that a contact ~~of~~ angle of < 25° has to be achieved in order to generate the necessary liquid film with a thickness of approximately 1 μm. This places a high demand on the surface energy of the print carrier primarily when one considers the extremely high surface tension value of water, namely 72 mN/M, as a basis of the ink-repelling fountain solution. Plastic print carriers or metallic print carriers can not achieve this without further measures such as, for example, roughening, application of surfactants, generation of microcapillaries, etc. For example, the contact angle of water to polyimide or polycarbonate is approximately 75°. Even metal surfaces that, in their purest form, exhibit very high surface energies and thus the smallest contact angles show relatively hydrophobic behavior under normal environmental conditions. This is substantially connected with the oxidation layer acting on metal surfaces that always forms under normal conditions. Even the slightest impurities have a negative effect in this context for the desired surface energy. Contact angles of over 70° are herewith frequently to be encountered in practice.

In the example according to Figure 6, a corona treatment of the surface of the print carrier 10 is effected for hydrophilization. A high-voltage generator 70 generates an alternating voltage in the range of 10 to 30 kV, preferably in the range of 15 to 20 kV, at a frequency of 10 to 40 kHz, preferably in the range of 15 to 25 kHz. An output connection of the high-voltage generator 70 is connected with an insulated electrode 72. The other output connection is, in the present case of a metallic print carrier 10, attached to a loop contact 74 that is connected with the print carrier 10.

The relatively high voltage at the electrode 72 leads to ionization of the air. A corona discharge is created, whereby the surface of the print carrier 10 is bombarded with free ions. Given a plastic surface, in addition to a cleaning effect in which organic impurities such as fat, oil, wax, etc. are typically removed, this leads to the creation of free radicals on the surface that form

strongly hydrophilic functional groups in connection with oxygen. They are hereby primarily carbonyl groups (-C=O-), carboxyl groups (HOOC-), hydroperoxide groups (HOO-) and hydroxyl groups (HO-). Given metallic print carriers, the cleaning effect is in the foreground, whereby an increase of the surface energy, and thus a reactivation of the hydrophilic properties of metals, is achieved via degreasing of the surface and removal of the oxide layer. In this manner, contact angles to water of under 20° can be achieved with plastic surfaces and with metal surfaces. The corona treatment modifies the physical surface properties of the carrier beforehand, however not its mechanical properties. No visible changes are detectable, for example with a scanning electron microscope. Via variation of the height of the voltage or the frequency of the high-voltage generator, the effect on the surface of the print carrier 10 can be influenced and attuned to the respective carrier material. The hydrophilization can be improved via supply of process gases, preferably oxygen or nitrogen.

In Figure 6, as in the example according to Figure 1, a fountain solution is applied onto the hydrophilized surface of the print carrier 10 in the dampening system 18; a structuring with the aid of laser radiation 28 subsequently occurs. The structured fountain solution layer is inked by the inking system 30 and the ink is later transfer-printed onto the carrier material 40. Ink residues are removed in the cleaning station 46. Since the surface of the print carrier 10 is very smooth, just as in the previous example, the cleaning process is simple and is to be realized with high effectiveness. The cyclical printing process can subsequently start anew. Alternatively, a restructuring can also be omitted and the previous print image is re-inked and transfer-printed.

Figure 7 shows the insulated electrode 72. A metallic core is surrounded by a ceramic jacket 78. In such a design, electrical arc-overs are prevented. This is primarily advantageous when metal is used as a print carrier 10. Alternatively, the insulation can also be generated via a plastic jacket.

Figure 8 shows the design in a print carrier 10 made from plastic. An electrode plate 80 is arranged on the side of the print carrier 10 that lies opposite the electrode 72. The electrode 72 can be executed without insulation.

Figure 9 shows a hydrophilization method with an indirect corona treatment. The output connections of the high-voltage generator 70 are connected with two electrodes 82, 84 that are arranged above the print carrier 10. The electrical discharges generated by the high voltage between the two electrodes 82, 84 generate ions that are conducted via an air flow or process gas flow onto the surface of the print carrier 10 and here deploy the wetting-aiding effect. A blower 86 is used to generate the flow.

Alternatively, a negative pressure plasma treatment can also be used that increases the surface energy on the surface of the print carrier 10. A high voltage discharge is hereby generated under vacuum conditions (for example in the range of 0.3 to 20 mbar), ionized by the process gas and excited into the plasma state. This plasma comes in contact with the surface of the print carrier 10. The effect of the plasma is comparable with the effect of the corona treatment.

A significant increase of the surface energy, which enables a very thin application of the frequency range fountain solution, is achieved with the aid of the hydrophilization process specified in Figures 6 through 9. The layer thickness is typically in the range of 1 µm.

Various advantages result via the specified hydrophilization method. The roughened, porous printing plate surface as in the standard offset printing method can be foregone. Instead of this, a very smooth surface is possible whose roughness range is very low, for example in a range of the average roughness value R_a < 1µm. A faster and more stable cleaning event is thereby possible for the surface. For the specified printing process, neither a permanent change in the molecular or, respectively, atomic structure of the material of the print carrier nor a wetting-aiding layer permanently and firmly anchored with the print carrier is necessary. Via the specified hydrophilization

process, the print carrier can be optimized with regard to further requirements without consideration of the surface energy.

The specified hydrophilization process also enables the omission of the wetting-aiding additives for fountain solution used in offset printing. A further application of additional wetting-aiding substances is no longer necessary. This prevents a relatively complicated process management and reduces the additional expenses on commodities. A further advantage is also in the cleaning effect of the hydrophilization method. It supports the cleaning process necessary for the digital printing method and thus further reduces the necessary hardware expenditure.

Figure 10 shows a further exemplary embodiment. In offset printing and in particular in the digital methods, for example according to US-A-5,067,404 and US-A-6,295,928 by the same applicant, the constant and precisely defined thickness of the fountain solution layer on the surface of the print carrier plays a decisive role for the stability and the efficiency of the printing method. According to the example according to Figure 10, a print device is specified that provides and monitors a defined, controllable and regulable very thin application of the fountain solution. In the standardized offset printing method, a dampening system is normally comprised of a number of rotating rollers used for the application of the fountain solution. Together with a roughened or porous printing plate directing good water, a water film sufficiently stable for the standard offset printing results. The fountain solution quantity and the thickness of the fountain solution layer can, for example, be adjusted via the adjustment of specific rollers relative to one another or the speed of the scoop roller. The storage effect of the dampening system as well as that of the printing plate hereby leads to a significantly retarded reaction to adjustment measures. However, for the generation of a sufficiently stable water film, the roughened, strong water-storing printing plates are absolutely necessary. From the prior art, it is also known to generate a very thin water film via cooling of the printing plate and the subsequent condensation of the humidity on the printing plate. The thickness of the water film is, however, strongly dependent on the environmental

conditions such as humidity and temperature and is hard to keep constant over longer periods of time.

In the exemplary embodiment according to Figure 10, a design is used that is similar to the design specified in the previously mentioned DE-A-101 32 204, which realizes a CTP method (Computer-To-Press method).

The print device shown in Figure 10 allows different print images to be generated on the same surface of the cylindrical print carrier 10. the print device comprises the inking system 30 with a plurality of rollers via which oil-containing ink is transferred from the reservoir 38 onto the surface of the print carrier 10. The inked surface of the print carrier 10 transfers the ink onto a rubber blanket cylinder 90. From there, the ink arrives on the paper web 40, which is pressed against the rubber blanket cylinder 90 via the counter-pressure cylinder 42.

The dampening system 18 transfers fountain solution (for example water) via three rollers from the fountain solution reservoir 24 onto the surface of the print carrier 10. Before the application of the fountain solution layer, the surface of the print carrier 10 can be brought to a hydrophilic state (as this has already been specified further above) using wetting agents and/or surfactants or via a corona and/or plasma treatment. In the further course, the fountain solution layer is selectively removed via energy supply by means of a laser beam 28 and the desired image structure is created. As mentioned, the inking via the inking system 30 subsequently occurs on the ink-attracting regions of the structuring. After the structuring, the ink can be solidified by means of a fixing device 92.

In this example, two operating modes are also possible. In a first operating mode, a plurality of printing events occurs before a restructuring of the surface. The print image located on the print carrier 10 is inked and transfer-printed once per printing, meaning a multiple inking of the print image occurs. In a second operating mode, a new print image is applied on the surface of the print carrier. For this, the previous structured ink-repelling layer as well as the ink residues are to be removed, for which the cleaning station 46 is provided. This cleaning station can be pivoted onto the print carrier 10

according to the arrow P2 and pivoted away again from said print carrier 10. Further details of the design of the print device according to Figure 10 are specified in the mentioned DE-A-101 32 204.

Viewed in the transport direction P1, an energy source 94 that emits heat energy onto the fountain solution film on the surface of the print carrier 10 is arranged after the dampening system 18. The thickness of the fountain solution layer is reduced with the aid of this energy. Viewed in the transport direction, a layer thickness measurement device 96 is encamped after the energy source. This layer thickness measurement device 96 determines the current thickness of the fountain solution film and emits an electrical signal corresponding to the thickness to a control 98. The control 98 compares the measured real thickness with a predetermined desired thickness. Given a desired-real value deviation, the energy source 94 is activated such that the thickness of the fountain solution layer is reduced to the desired thickness.

The layer thickness measurement device 96 can, for example, operate without contact according to the triangulation method, the transmission method or the capacitive method. One or more IR lamps, heat radiators, laser systems, laser diodes or heating elements are suitable as energy sources 94.

The cooperation of the energy source 94, the layer thickness measurement device 96 and the control 98 can be such that only a monitoring function is effected. When the layer thickness undershoots or overshoots a predetermined desired value, a corresponding warning signal is emitted and the energy supply for the energy source 94 is readjusted based thereon. The energy source 94, the layer thickness measurement device 96 and the control 98 can, however, also be incorporated into a control circuit in which the energy source 94 is activated such that, given a standard deviation between real value and desired value of the layer thickness, this standard deviation is minimized and preferably regulated to zero.

The energy source 94 can be activated by the control with the aid of an analog voltage regulation or digitally via a pulse modulation, as this is indicated by the signal series 100.

According to the example according to Figure 10, in a first process step a fountain solution film that is constant in terms of thickness is generated over the useable width of the print carrier 10, the fountain solution film being reduced in terms of its layer thickness defined in a subsequent second step. The result is a uniform fountain solution layer with defined and very slight thickness. The subsequent structuring can thus be implemented with minimal energy and with invariable result. Overall, the print quality is thus increased. The advantages of the shown print device are that an immediate reaction to a change of the layer thickness of the fountain solution layer can ensue, that a known and defined thickness of the fountain solution layer can be set, and that extremely thin fountain solution layers can be generated. The necessary structuring energy can also be minimized, in particular for digital printing methods.

Numerous further variations of the previously specified exemplary embodiments are possible. For example, both a continuous band and a cylinder can be used as a print carrier. The transfer printing onto the carrier material can ensue directly or under interposition of a rubber blanket cylinder or, respectively, further intermediate cylinders for an ink separation. The layer thickness regulation according to the example according to Figure 10 can also be used for the other examples. Likewise, a fixing of the applied ink with the aid of a fixing device can occur for the examples according to Figures 1 through 9. Furthermore, the cleaning station 46, the dampening system 18 and the image generation device can be switched to inactive and active, for example via swinging.

While a preferred embodiment has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention both now or in the future are desired to be protected.

I CLAIM AS MY INVENTION: